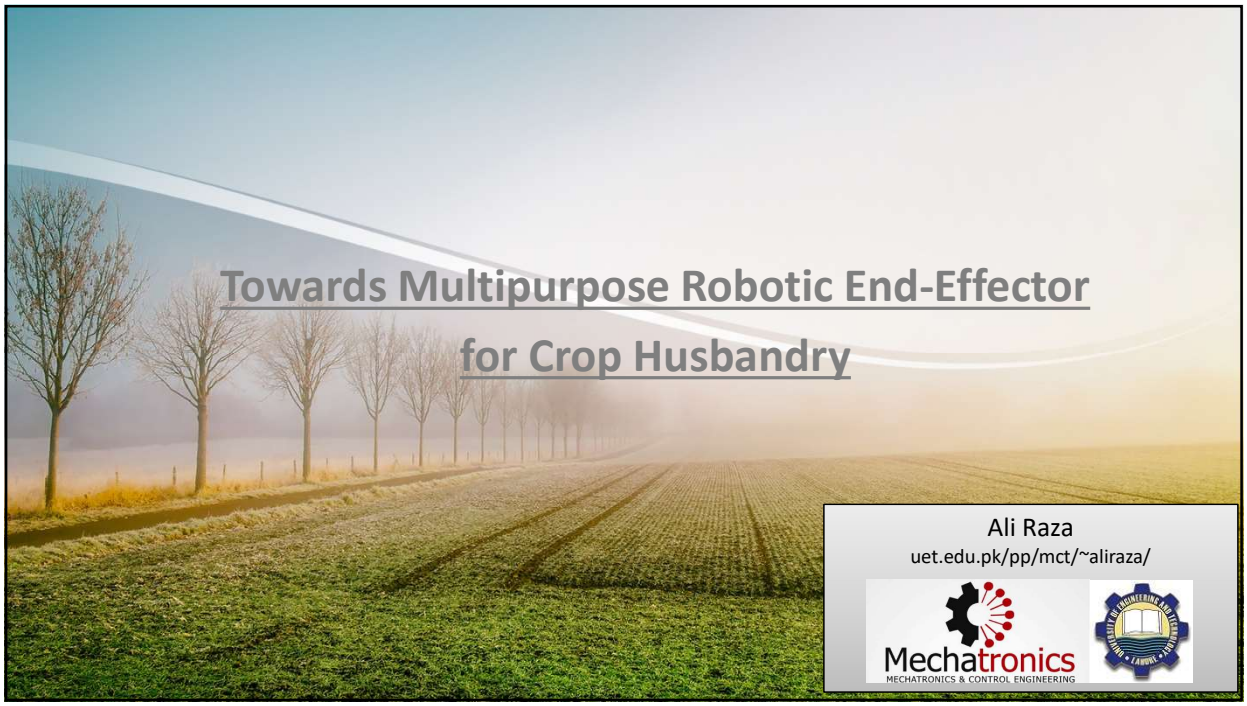
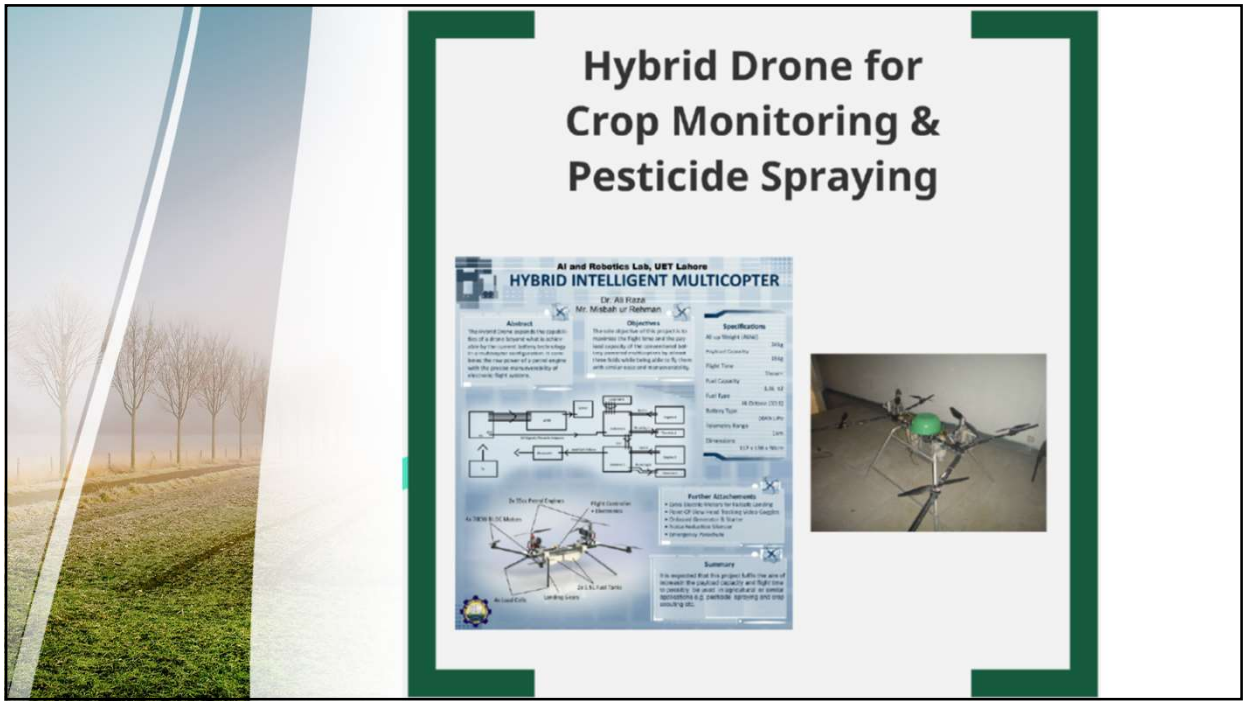

Towards Multipurpose Robotic End-Effector
for Crop Husbandry
Ali Raza
uet.edu.pk/pp/mct/~aliraza/
Mechatronics
MECHATRONICS & CONTROL ENGINEERING


LAST YEAR


Robotic Pest Scouting &
Crop Monitoring
Concept:
Development:
Currently!


Hybrid Drone for
Crop Monitoring &
Pesticide Spraying
AI and Robotics Lab, UET Lahore
HYBRID INTELLIGENT MULTICOPTER

Smart Agri-Sensor

Concept:

A sensor
- collecting in-situ data
- communicating it to remote location
- to determine localized needs for:
  - irrigation
  - fertilizing

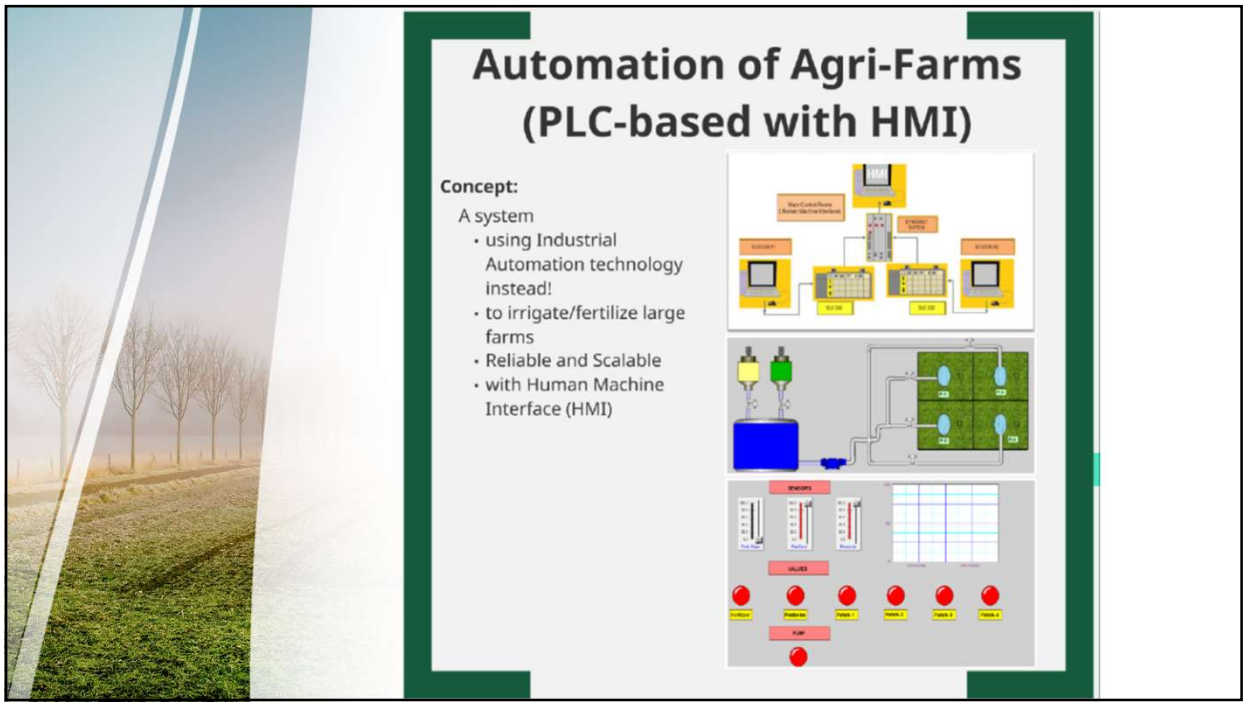
Features:

- pH Sensor
- Soil Moisture
- Air Humidity
- GSM Modules
- GPS Module
- RF Modules
- Local LCD Display
- Android App

Run-of-the-River Turbine and Testbed

in collaboration with Petronas

Testbed was developed by our Lab
Turbines were developed by supervised student groups


Automation of Agri-Farms
(PLC-based with HMI)
Concept:
A system
• using Industrial Automation technology instead!
• to irrigate/fertilize large farms
• Reliable and Scalable
• with Human Machine Interface (HMI)

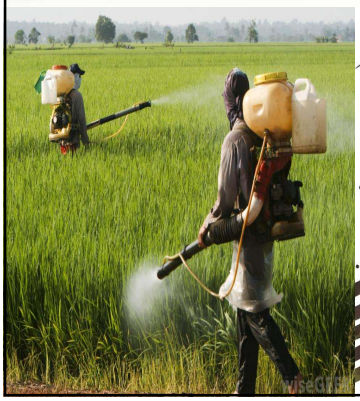

THIS YEAR

Conventional Methods

1. ***Excessive use of Pesticides***
   - *Adverse effects on health of soil & Environment*
2. ***Excessive Tillage***
   - *High Energy Consumption*
   - *Affects soil structure*
3. ***Broadcasting the Seeds by Hand***
   - *Labor intensive*
   - *High Seed Waste*
   - *Uneven Distribution*
4. ***Excessive use of Water for Irrigation***
   - *Waste of resources*

Conventional Methods

Excessive Use of Pesticide



broadcasting the seeds by Hand

Conventional Irrigation

Tillage

CAN A MULTIPURPOSE TOOL BE DESIGNED?

Agri-Activity	Conventional/ Traditional Method	Proposed Method	Intended Benefits
Seedbed Preparation	1. Ploughing	Minimum tillage (agitation) through specially designed sowing tool	• Energy conservation • Soil preservation
Seeding	1. Throwing seeds 2. Manual Planters	The same tool having the seeding mechanism	• Minimization of seed wastage • Precision in depth & spacing
Irrigation	1. Open Water Channels	Targeted irrigation through robotic movement and sowing tool	• Greatly reducing the required water quantity

Agri-Activity	Conventional/ Traditional Method	Proposed Method	Intended Benefits
Fertilizer Distribution	1. Throwing fertilizer 2. Mixing in Water Channels	Water soluble fertilizer distributed through the robotic end-effector	• Optimized use of fertilizer (saving the cost!)
Pesticiding	1. Separate Pesticide Spraying	Integrated pesticide spraying	• Product and labor cost will be saved
Weeding	1. Manual 2. Weeding Chemicals	Robotic agitation to weed out the unwanted plants	• Savings in cost of labor/ weeding chemicals
Soil Monitoring	1. Manual operation	Automatically through Soil Sensor	• Optimal management of soil health.

Literature Review

- **Farm-Bot Genesis**
  - *Open source Blog*
- **Agricultural Robot for automatic ploughing and seeding**
  - *Ankita.A, Abirami.E, Amrita Sneha.A*
- **Autonomous Agricultural Robot towards robust autonomy**
  - *Martin Holm Pedersen & Jens Jense*
- **Valley Irrigation Pakistan**
  - *Farming Solution providers*

Farm-bot Genesis (By Rory Anderson - California)

Literature Review

- **Iowa Agriculture literacy foundation**
  - *Agriculture Blog by WILL*
- **Soil Quality**
  - *Article by Dr Lengnick)*
- **Implementation of remote control for a spraying robot**
  - *by Chun-Mu Wu, Jui-Tsung Lu*
- **CROPWATCH-Institute of Agriculture and natural Resources**
  - *by University of Nebraska-Lincoln)*

Objectives:

To Develop a Multipurpose Robotic End-Effector that incorporates:

- An Automatic digging mechanism
- An Automatic seed sowing mechanism
- A system that can irrigate or fertigate fields efficiently.
- A feedback system that can detect moisture level of the field.
- A system for weed detection and its effective removal.
- A system that can effectively spray pesticide.

- All packaged in one product
- Reconfigurable
- Versatile

COMPARISON TABLE:

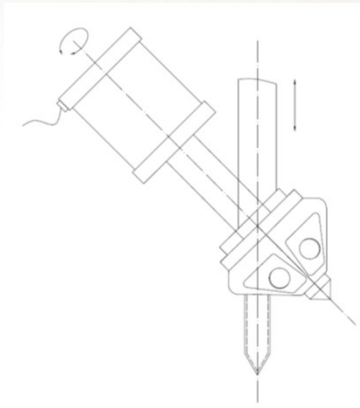
Products	*Farm-Bot Genesis*	*Maestro SW*	*Hand Seeder*	*C-P Irrigation System*	*Conventional Farming*	*Our tool mounted on C-P*
Ability to serve in Big Fields	○	●	◔	●	◑	●
Pest Control system	◔	○	○	○	◑	●
Even seed Dispensing	●	●	◑	○	○	●
Automation	●	◑	○	●	○	◕
Eco-Friendly	●	◕	●	◕	◕	●
Irrigation/ Fertigation	●	○	○	◕	◑	●

Initial Design Multipurpose End-Effector

Multipurpose End-Effector

Out of a number of initial options, an indexing tool design was considered to be the best option.

Selection Criterion:
- Expert Opinion
- Ranking on design objectives



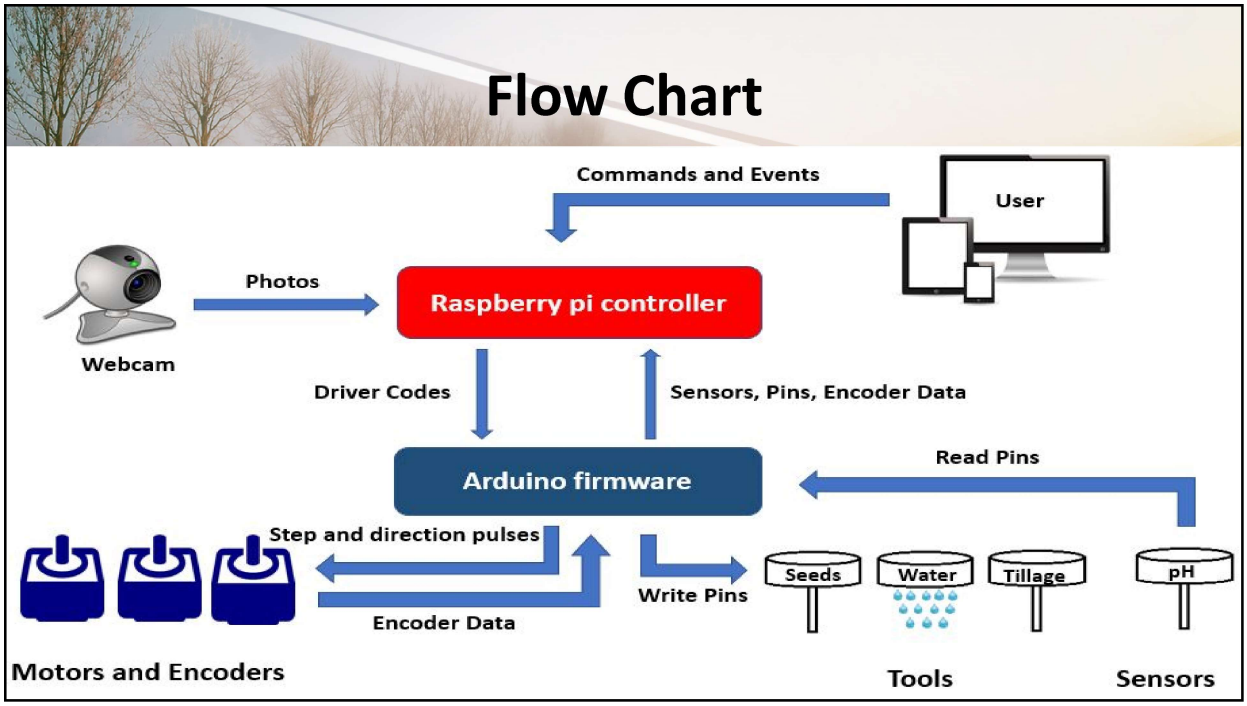
Applications & Scope

Applications:
- Can be installed in any field ranging from medium to large for best performance and profit.
- Can be installed temporarily with the existing Central Pivot Irrigation system (rental services).
- Can perform Sowing , Tillage and Irrigation/Fertigation efficiently.

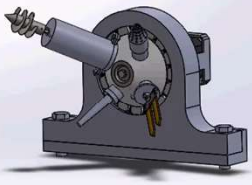
Scope:

There is still a lot of room for improvement like:
- Can be made power efficient by equipping it with solar Panels.
- Can be used for Poly cultured and Mono Cultured Farms.
- Can benefit the economy if widely practiced.
- Can incorporate online data and cloud services.

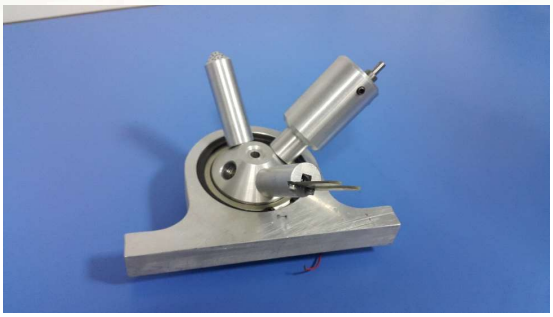
Flow Chart



How it Works!



Final Assembly



- Two patents pending in Pakistan
- One US patent pending in USA


Any Questions !